

- Migration issues will affect frame relay adversely to the extent that the availability of frame-to-ATM service interworking and T1 ATM encourages customers to implement ATM at their hub sites. Meanwhile, however, carrier pricing initiatives that emphasize port pricing more than PVC and committed information rate (CIR) measurements will encourage users to implement meshed networks with connections to additional sites within the organization. The need for communication among more locations, the increase in peer-to-peer (as opposed to peer-to-hub) communications, and the increasing availability of higher-speed frame relay access is driving the demand for frame relay as it also fuels demand for backbone links to ATM.
- At midyear 1997, Sprint led the national/international frame relay services market with 31.1% of revenue, followed by AT&T with 27.8% and MCI with 24.1%. U S West led the local frame relay market with a 28.7% market share, followed by Pacific Bell (17.4%) and Bell Atlantic (14.2%).

ATM Services

The ATM services market amounted to \$76.5 million in 1996 and will increase at a 1996–2001 CAGR of 92%. The following factors will play a role in influencing the ATM service market:

- T1 ATM services have already begun to affect the market. Most local and national providers have already rolled out the service, which provides a lower-cost entry for smaller customers (particularly for multimedia traffic) and facilitates the expansion of ATM connectivity to smaller sites.
- Additional ATM functionality will contribute to more mass-market business acceptance of ATM. AT&T introduced ATM switched virtual circuits (SVCs) in early 1997, and most other providers plan commercial rollouts in 1997 or 1998. The benefits associated with SVCs include increased network flexibility and scalability, point-to-multipoint connection capabilities, the ability to communicate with users of other providers' ATM services, and (in some cases) lower per-month charges.
- The growth of the Internet is a key driver for the ATM market because ISPs are implementing ATM in their backbones to aggregate traffic and connect to network access points. During late 1996 and early 1997, many providers reported increased sales to ISP customers.
- At midyear 1997, Sprint led the national/international ATM services market with 41.9% of revenue, followed by AT&T (22.1%) and MCI (17.2%). Pacific Bell led the local ATM market with 24.4% of revenue, closely trailed by second-place Ameritech (21.0%), and Bell Atlantic (15.4%) edged out GTE (15.1%) for third place.

X.25 Services

X.25 remains a key market segment, having generated revenue of \$711.8 million in 1996. However, X.25 is not a long-term growth market; its 1996–2001 CAGR falls just under 2%. The following factors are expected to affect the X.25 services market:

- The total X.25 market will grow only slightly during the forecast period as migration to frame relay and IP services erodes the customer base.
- The slight market growth will be fueled by customers' continued use of X.25 service for traditional applications such as financial transactions, as well as more recent applications such as remote LAN access. Online service providers also use X.25 as an Internet connectivity option.
- The X.25 market will grow more rapidly outside the United States, and a significant portion of U.S.-based providers' revenue will result from traffic originating from overseas.
- At midyear 1997, Sprint led the national/international X.25 services market with 74.5% of revenue, followed by CompuServe (7.3%) and MCI (6.8%). Nynex led the local X.25 market with 27.7% of revenue, followed by Pacific Bell (26.9%) and BellSouth (16.9%).

SMDS

The SMDS market grew by 69% from 1996 to 1997 and will experience a 1996–2001 CAGR of 28%. The following factors will affect growth within the SMDS market:

- SMDS will enjoy continued success in specific industry sectors that value high-bandwidth connectionless services and in those that tend to have a large number of sites or partners within a certain geographic area. These vertical markets include publishing/printing, entertainment, real estate, finance, and health care. SMDS's any-to-any connectivity enables these industries to bring dispersed sites together in easy-to-implement mesh networking topologies.
- Currently, SMDS possesses some unique service capabilities (any-to-any connectivity and multicasting). However, service providers' implementation of ATM SVCs (connectionless ATM) may steal some of SMDS's thunder. In addition, ATM holds out the promise of consolidation of data, voice, and video traffic; there are no voice applications for SMDS.
- MCI is currently the only national/international provider of SMDS. At midyear 1997, Bell Atlantic led the local SMDS market with 40.1% of revenue, followed by Ameritech (31.5%) and Pacific Bell (20.9%).

Scope and Methodology

Scope

This report analyzes the market for packet/cell-based services (frame relay, ATM, X.25, and SMDS) provided by local exchange carriers (LECs), interexchange providers (IXCs), and value-added network (VAN) service providers. The data presented in this study is segmented by provider type — local and national/international — based on the providers' service areas. IDC takes this approach because it reflects the current structure of the U.S. telecommunications market in the early days of deregulation. As the local providers become fully deregulated and carrier consolidation develops, IDC expects many LECs to evolve into regional service providers. Some providers, such as U S West and possibly GTE, will leverage relationships with other providers to roll out national offerings for some service segments. Should these relationships develop, the segmentation analysis will change or become moot.

This report presents U.S.-based providers' market share by revenue and ports for the year ending 1996 and for midyear 1997. Profiles of major service providers' services and strategies are also included. Five-year revenue and port forecasts are presented for the four packet/cell-based service segments, as well as forecasts reflecting market segmentation by port speed, geographic region, and customer type. The report also includes forecasts by provider segment, presenting the relative market shares of local versus national/international providers in each market segment in 2001.

This report covers transmission *services* only and does not include any software, hardware, or consulting services as part of overall service subscription packages.

Note: All numbers presented in this document may not be exact due to rounding. The data presented in this report does not take account of recent industry mergers and acquisitions. As a result, Bell Atlantic and Nynex, SBC and Pacific Bell, and LDDS WorldCom and MFS are presented as separate entities.

Market Segment Definitions

X.25 Services

Based on the ITU-T standard, X.25 is a reliable, packet-based transmission medium for data. Widely used both in the United States and internationally, X.25 does not require high-quality network connections. Instead, it relies on embedded redundancy and error checking to ensure network availability and uses a store-and-forward transmission process when a designated path is not available.

However, what makes X.25 highly reliable also accounts for its shortcomings. The store-and-forward process is cumbersome, resulting in longer turnaround times. X.25 is ideal for mission-

critical applications that are not necessarily time critical. X.25 services can be accessed via dial-up or dedicated connections.

Frame Relay Services

Like X.25, frame relay divides the data transmission into packets for transport across a carrier's network. Available via dial-up and dedicated connections, frame relay carries data much faster than X.25 because it is not bogged down by the error correction that makes X.25 so reliable.

Frame relay networks are rarely at 100% utilization; thus, they allow for occasional bursts of data above subscribed levels, making frame relay an attractive alternative for LAN traffic. Carriers also are increasingly supporting SNA over frame relay services.

Frame relay generally supports access speeds up to T1, but recently many carriers have rolled out frame relay service at fractional T3 and full T3 access speeds.

ATM

ATM is a connection-oriented, cell-based service. Built on a 53-byte cell architecture, ATM is used either as a transport medium or as a backbone supporting other transport protocols such as frame relay and IP. Although frame relay carries data traffic almost exclusively, ATM promises to support multimedia applications, combining voice, data, and video.

ATM supports flexible bandwidth allocation, making it appropriate for WAN traffic. ATM is most widely offered at T3, and most carriers also have OC-3 offerings. Increasingly, both local and national carriers are introducing ATM at T1.

ATM features several classes of service. Constant bit rate (CBR) is designed for real-time applications requiring a fixed amount of bandwidth (i.e., a continuously available peak cell rate). Variable bit rate, real-time (VBR-RT) service, is intended for bursty, time-sensitive applications such as voice and video. VBR nonreal-time (VBR-NRT) service is designed for bursty applications that are not time sensitive. Available bit rate (ABR) is designed for delay-tolerant traffic. ABR connections have specified maximum and minimum cell rates. ABR service is well suited to LAN interconnection and TCP/IP connectivity. Unspecified bit rate (UBR) is a best-effort service category designed for applications that are not time sensitive. No resource allocation is performed, nor is bandwidth or quality of service specified.

At present, all service providers support CBR and VBR nonreal-time classes of service, and many are also supporting VBR-RT and UBR. However, relatively few carriers have plans to introduce ABR services.

SMDS

SMDS, like ATM, is a cell-based service built on a 53-byte cell structure. Unlike ATM, however, SMDS is a connectionless data service as defined by Bellcore's B-ISDN broadband architecture. SMDS supports access speeds between 56Kbps and 34Mbps and is characterized by its multicasting and any-to-any connectivity capabilities.

Methodology

This report reflects IDC's ongoing research in packet/cell-based service markets. It is based on both public and proprietary information sources, and this research is used to generate the forecasts and market share analysis in this report. Forecasts are based on historical growth, insights from IDC's consulting experience, and discussions with service providers and equipment manufacturers.

Packet/Cell-Based Services Market Overview

Market Share, Midyear 1997 and Yearend 1996

Sprint leads the overall market, accounting for 39.7% of revenue at midyear 1997, followed by AT&T and MCI with 17.1% and 16.5%, respectively.

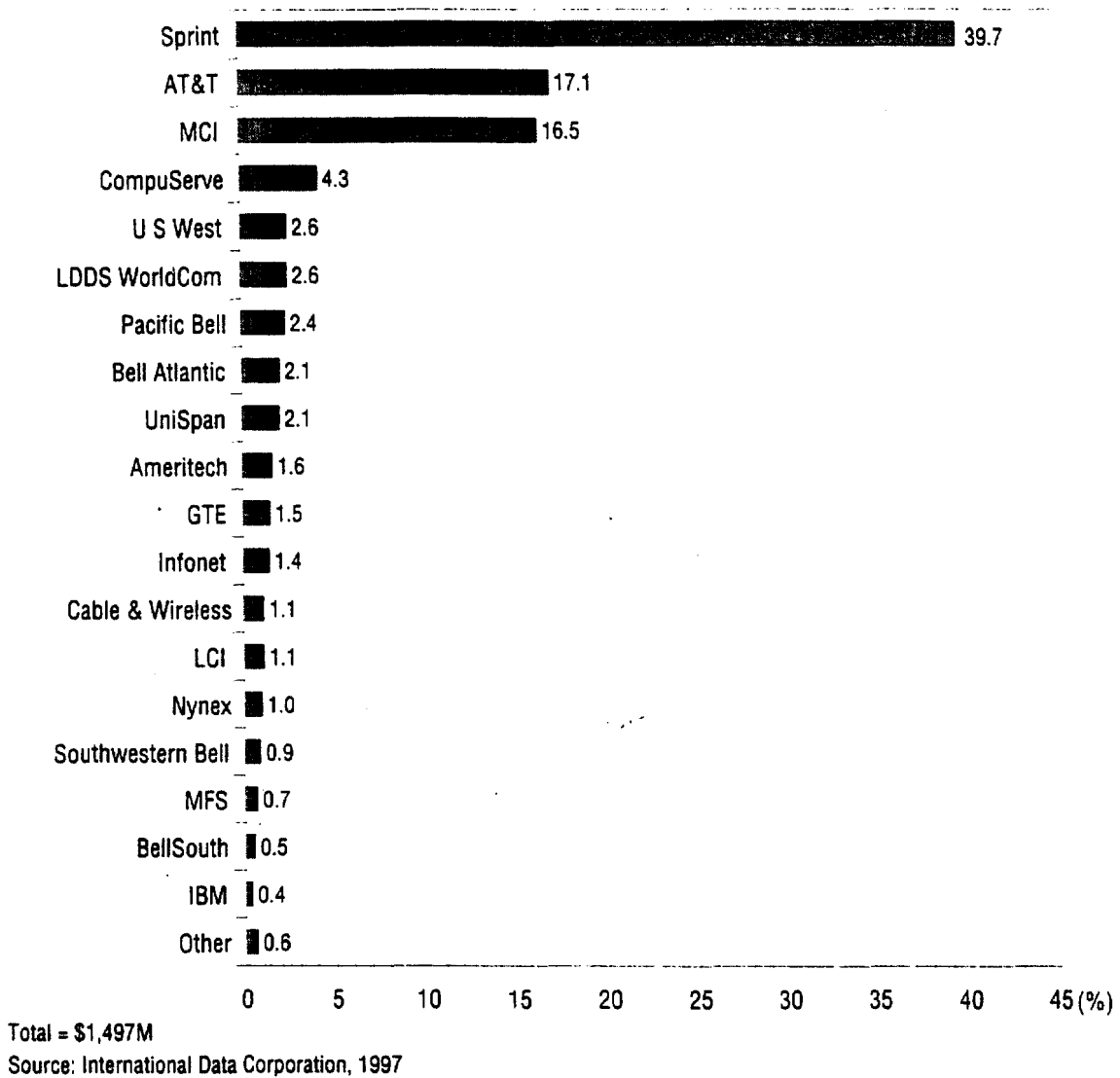
Table 1 shows local and national/international providers' packet/cell-based service offerings. Figures 1 and 2 present IDC's market share data for midyear 1997 and yearend 1996. Sprint leads the overall market, accounting for 39.7% of revenue at midyear 1997, followed by AT&T and MCI with 17.1% and 16.5%, respectively. From yearend 1996 to midyear 1997, Sprint experienced a 2.4% market share loss, primarily in favor of MCI and AT&T. Nevertheless, Sprint remains in first place overall because of its dominance of the X.25 market and its strong showing in the ATM market. Among local providers, U S West captured a commanding lead in the local frame relay market to garner a 2.6% share of total revenue.

Table 1
U.S. Providers' Packet/Cell-Based Service Offerings, Midyear 1997

Company	X.25	Frame Relay	ATM	SMDS
LECs				
Ameritech	X	X	X	X
Bell Atlantic	X	X	X	X
BellSouth	X	X	X	X
Nynex	X	X	4Q1997	Not offered
Pacific Bell	X	X	X	X
Southwestern Bell	X	X	X	Not offered
U S West	X	X	X	Not offered
IXCs				
AT&T	X	X	X	Not offered
Cable & Wireless	X	X	Not offered	Not offered
LCI International	Not offered	X	Not offered	Not offered
LDDS WorldCom	X	X	X	Not offered
MCI	X	X	X	X
Sprint	X	X	X	Not offered
VAN providers/CLECs				
CompuServe	X	X	Not offered	Not offered
GTE	X	X	X	X
IBM	X	X	Not offered	Not offered
Infonet	X	X	Not offered	Not offered
MFS	Not offered	X	X	Not offered
UniSpan	Not offered	X	Not offered	Not offered

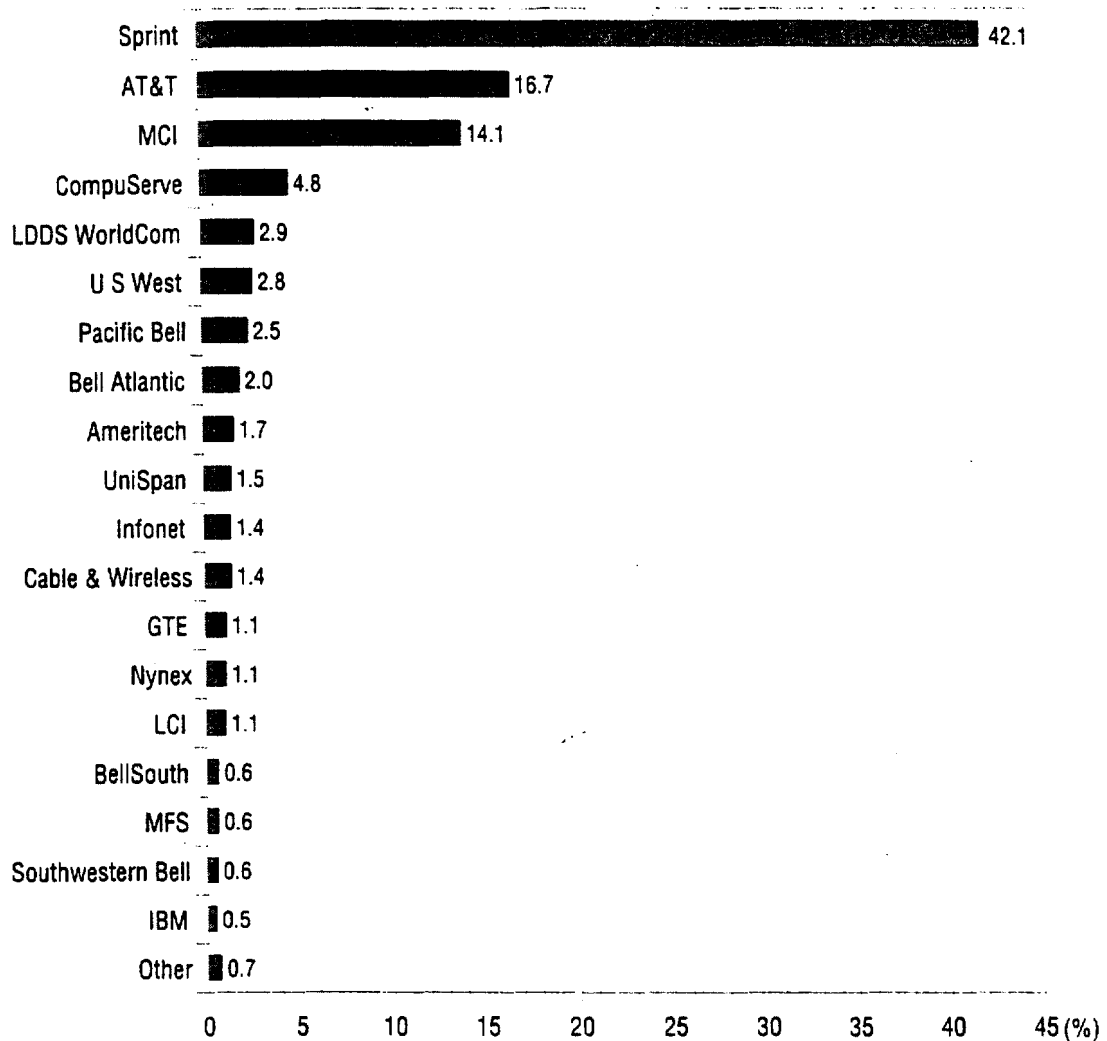
Source: International Data Corporation, 1997

Figure 1
Total U.S. Packet/Cell-Based Service Revenue by Provider, Midyear 1997



Individual service segment market share data based on both revenue and ports are presented in subsequent sections of this report.

Figure 2
Total U.S. Packet/Cell-Based Service Revenue by Provider, Yearend 1996



Total = \$1,998.2M

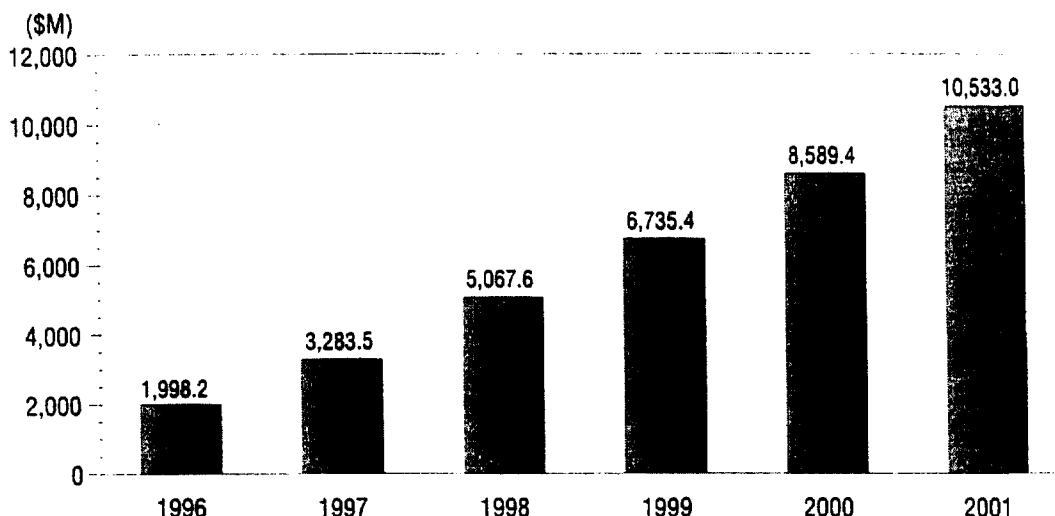
Source: International Data Corporation, 1997

Revenue Forecast, 1996-2001

IDC forecasts that the total packet/cell-based services market will grow to more than \$10.5 billion in 2001, representing a 1996-2001 CAGR of 39%.

As illustrated in Figure 3, the total packet/cell-based services market will reach nearly \$3.3 billion by yearend 1997, representing a growth rate of 64% from 1996's total of approximately \$2.0 billion. IDC forecasts that the total packet/cell-based services market will grow to more than \$10.5 billion in 2001, representing a 1996-2001 CAGR of 39%. The market for packet/cell-based network services will be comparable to that of the private line market by the end of the forecast period.

Figure 3
Total U.S. Packet/Cell-Based Service Revenue, 1996–2001



Source: International Data Corporation, 1997

Developments such as new customer growth, expansion of existing customers' networks, the impact of new types of customers such as ISPs, and customer migration between different data services — in particular, away from private lines — are fueling the growth of this market.

Overall, the market is being driven by the increasing connectivity requirements of businesses, governmental and educational institutions, and network service providers. More specifically, developments such as new customer growth, expansion of existing customers' networks, the impact of new types of customers such as ISPs, and customer migration between different data services — in particular, away from private lines — are fueling the growth of this market.

Table 2 presents the total packet/cell-based services revenue forecast, as well as the forecast for the individual services. Figure 4 presents the comparative revenue contribution of each service segment. At yearend 1996, frame relay led the market with more than 58% of total market revenue. During the forecast period, IDC expects the overall contribution of frame relay to increase to nearly 73% of market revenue as the service matures and is perceived as more of a mass-market business offering. ATM will also become a more important player in the packet/cell-based services market, reaching 19% of overall revenue in 2001. The X.25 segment's share of total revenue will decrease dramatically through 2001 because of customer migration to other technologies and continued pricing pressure on X.25 services. IDC expects SMDS to remain a niche service, accounting for 1.4% of the total market in 2001.

Customer Connection Forecast, 1996–2001

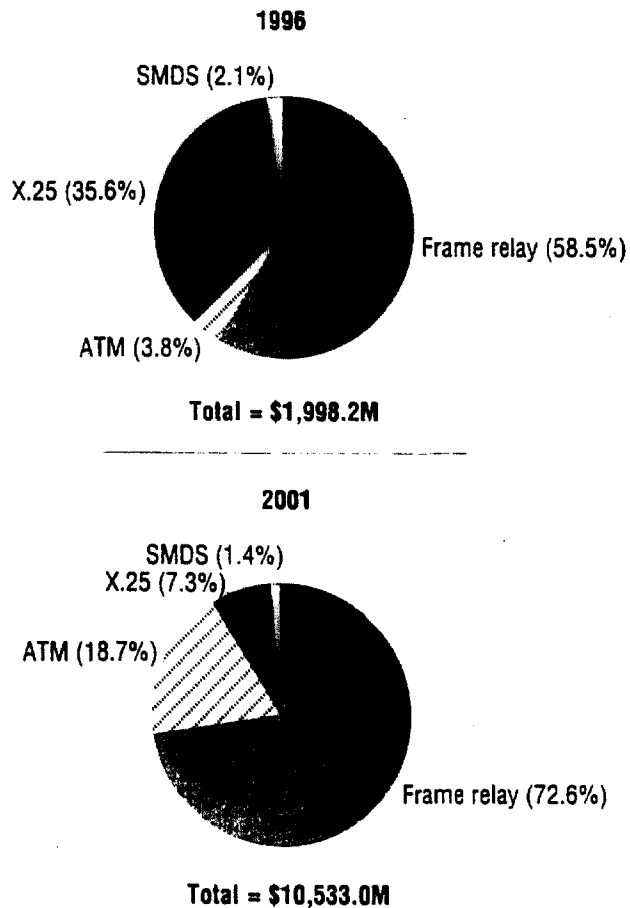
The total number of packet/cell-based connections will grow from 416,227 at yearend 1996 to more than 1.8 million in 2001, a CAGR of 35% (see Table 3 and Figure 5).

Table 2
U.S. Packet/Cell-Based Service Revenue by Segment, 1996-2001 (\$M)

	1996	1997	1998	1999	2000	2001	1996-2001 CAGR (%)
Frame relay	1,168	2,191	3,708	5,066	6,381	7,644	45.6
ATM	76	232	442	728	1,268	1,971	91.5
X.25	712	790	822	824	805	769	1.6
SMDS	42	72	95	118	135	148	28.1
Total	1,998	3,284	5,068	6,735	8,589	10,533	39.4

Source: International Data Corporation, 1997

Figure 4
U.S. Packet/Cell-Based Service Revenue Share by Segment, 1996 and 2001



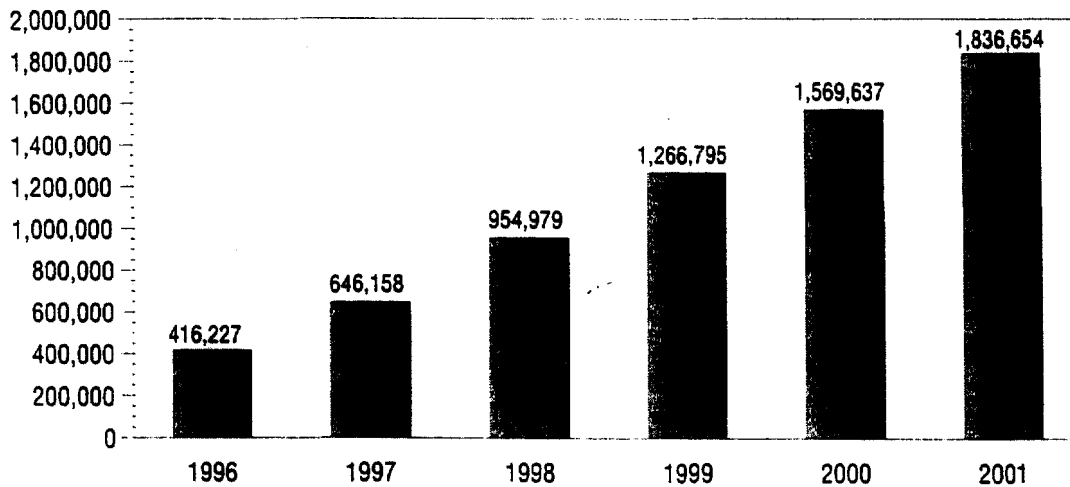
Source: International Data Corporation, 1997

Table 3
U.S. Packet/Cell-Based Service Port Installed Base by Segment, 1996-2001

	1996	1997	1998	1999	2000	2001	1996-2001 CAGR (%)
Frame relay	260,024	463,114	749,610	1,040,447	1,325,330	1,577,411	43.4
ATM	1,067	2,966	5,695	9,962	17,588	27,787	92.9
X.25	148,252	169,905	186,282	200,632	209,084	212,573	7.5
SMDS	6,883	10,172	13,392	15,754	17,635	18,884	22.4
Total	416,227	646,158	954,979	1,266,795	1,569,637	1,836,654	34.6

Source: International Data Corporation, 1997

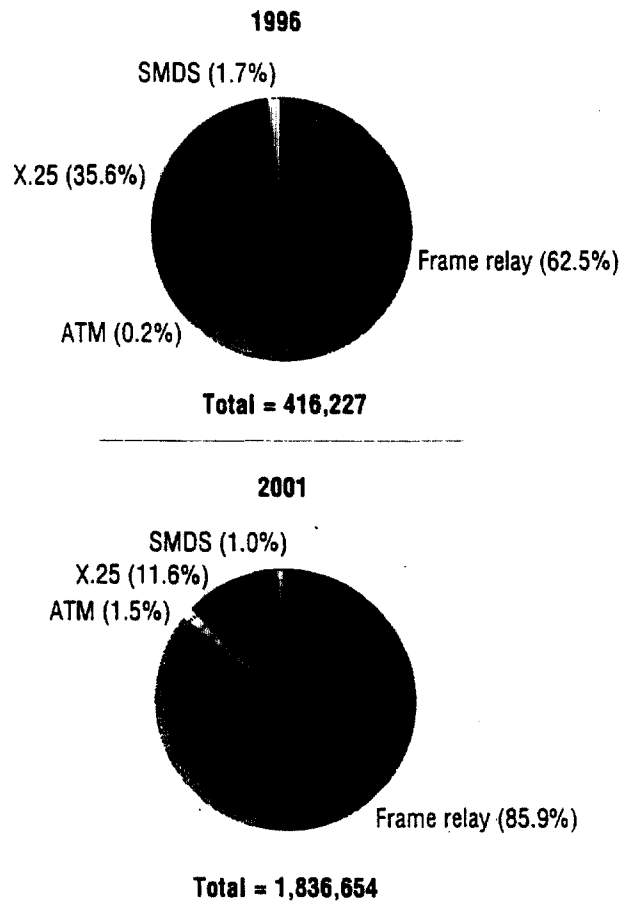
Figure 5
Total U.S. Packet/Cell-Based Port Installed Base, 1996-2001



Source: International Data Corporation, 1997

Figure 6 shows the relative contribution of each service segment to the total port count. At yearend 1996, frame relay represented 62.5% of total packet/cell-based connections. IDC expects that frame relay will experience strong growth throughout the forecast period, representing almost 86% of total connections in 2001.

Figure 6
U.S. Packet/Cell-Based Port Installed Base Share by Segment, 1996 and 2001



Source: International Data Corporation, 1997

Revenue Forecast by Customer Segment, 1996–2001

IDC examined four customer segments for this study: corporate, education, government, and other network service providers. Table 4 presents IDC's packet/cell-based services revenue forecast by customer segment. Figure 7 reflects the overall contribution of each customer segment to total packet/cell-based service market revenue from 1996 to 2001.

Corporate customers accounted for nearly 59% of total packet/cell-based services revenue in 1996, followed by other network service providers (mostly ISPs) with 21% and government and education users, who accounted for 12% and 8% of total revenue, respectively.

During the forecast period, there will be slight shifts in the overall mix, IDC expects. Corporate customers will account for more than 62% of total packet/cell-based services revenue in 2001, followed by

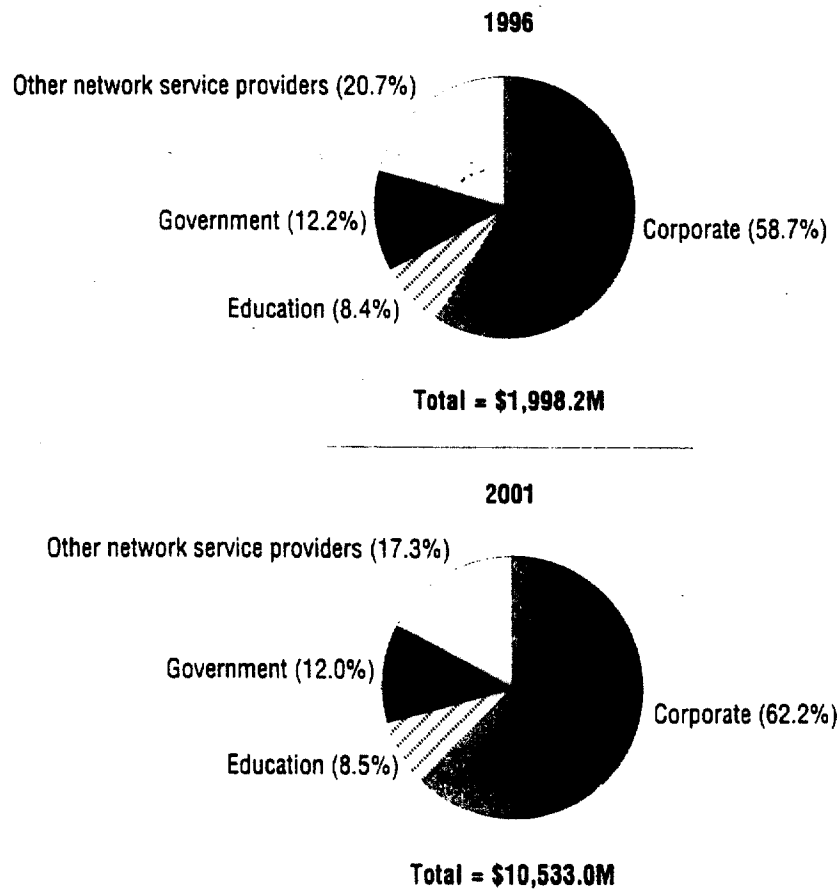
other network service providers with 17%, government with 12%, and education with 8%.

Table 4
U.S. Packet/Cell-Based Service Revenue by Customer Type, 1996–2001 (\$M)

	1996	1997	1998	1999	2000	2001	1996–2001 CAGR (%)
Corporate	1,174	1,969	3,071	4,113	5,302	6,555	41.0
Education	167	305	491	644	774	895	39.8
Government	243	451	718	932	1,119	1,264	39.0
Other network service providers	413	560	787	1,046	1,394	1,819	34.5
Total	1,998	3,284	5,068	6,735	8,589	10,533	39.4

Source: International Data Corporation, 1997

Figure 7
U.S. Packet/Cell-Based Service Revenue Share by Customer Type, 1996 and 2001



Source: International Data Corporation, 1997

National/International Revenue Forecast by Region, 1996-2001

IDC examined the revenue of the national/international packet/cell-based service providers (IXCs and VAN providers) by geographic region. Table 5 presents revenue derived from services originating in the United States, Western Europe, Asia/Pacific, and the rest of the world (ROW). Figure 8 illustrates the relative contribution of each region to the U.S.-based national/international providers' total market revenue.

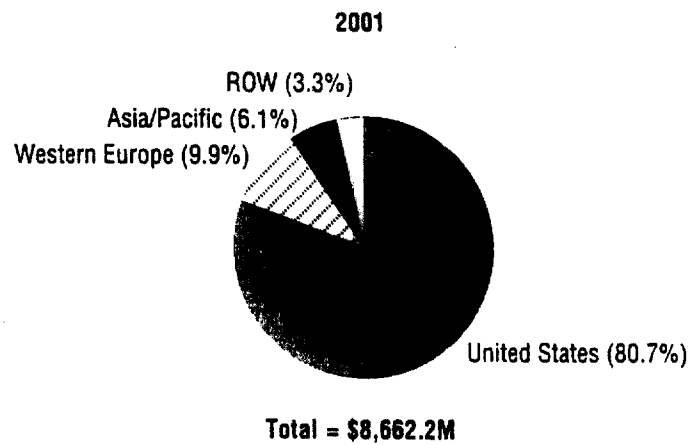
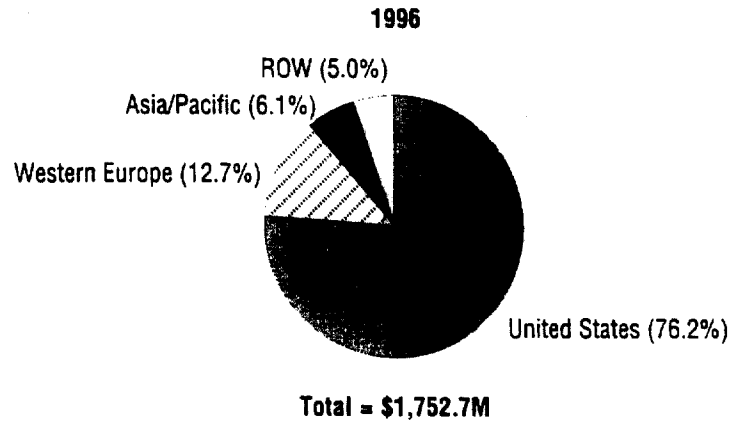
According to IDC, the U.S. share of the total U.S.-based provider market will increase during the forecast period, from approximately 76% of the total in 1996 to nearly 81% in 2001 because of slow international growth of U.S.-based providers' frame relay and ATM revenue. The U.S. portion of U.S.-based providers' X.25 revenue will decline more dramatically, but this development will have little effect on the total, given that IDC expects U.S.-based providers' X.25 revenue to be essentially flat during the forecast period. The assumptions behind these forecasts are described in more detail in each of the service-specific sections of this report.

Table 5
U.S.-Based National/International Packet/Cell-Based Service Revenue by Region, 1996-2001 (\$M)

	1996	1997	1998	1999	2000	2001	1996-2001 CAGR (%)
United States	1,335	2,215	3,413	4,471	5,689	6,992	39.3
Western Europe	223	335	490	619	738	855	30.8
Asia/Pacific	107	171	244	331	430	525	37.5
ROW	87	122	160	206	253	290	27.1
Total	1,753	2,844	4,308	5,627	7,111	8,662	37.7

Source: International Data Corporation, 1997

Figure 8
U.S.-Based National/International Packet/Cell-Based Service Revenue Share
by Region, 1996 and 2001



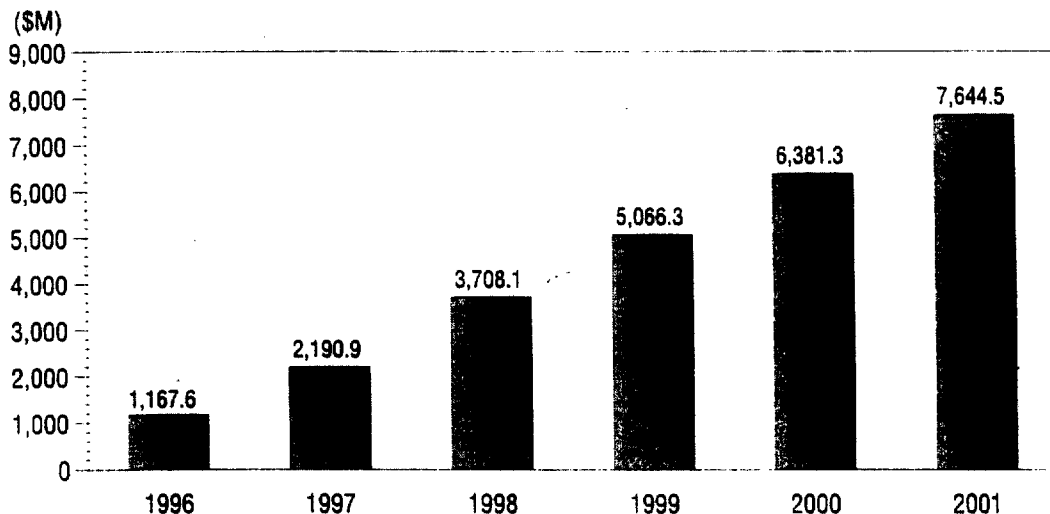
Source: International Data Corporation, 1997

Frame Relay Services

The market for frame relay services will reach nearly \$2.2 billion in 1997, an 88% increase from 1996's \$1.2 billion.

IDC's research shows that the market for frame relay services will reach nearly \$2.2 billion in 1997, an 88% increase from 1996's \$1.2 billion (see Figure 9). In 2001, the market will increase at a 1996–2001 CAGR of 46%, to \$7.6 billion. Since its redesignation as a carrier service by the FCC in 1995, frame relay has come into its own, emerging as a mass-market business service. Enhanced features and value-added capabilities such as disaster recovery/backup options, higher-speed connectivity, SNA over frame relay, dial access alternatives, and managed service options will continue to drive frame relay growth.

Figure 9
U.S. Frame Relay Service Revenue, 1996–2001



Source: International Data Corporation, 1997

The frame relay market will maintain a 1996–2001 CAGR of nearly 46%.

IDC predicts that the frame relay market will continue to grow at a healthy pace. As Table 6 illustrates, the total number of frame relay customers and ports will increase dramatically at 1996–2001 CAGRs of 32% and 43%, respectively. However, overall market growth will begin to slow slightly toward the end of the forecast period as pricing pressures in both the local and national/international market drive average revenue per subscriber downward. Nevertheless, the frame relay market will maintain a 1996–2001 CAGR of nearly 46%.

Fractional T3/T3 and T1 ports will experience the fastest growth, with CAGRs of 134% and 57%, respectively.

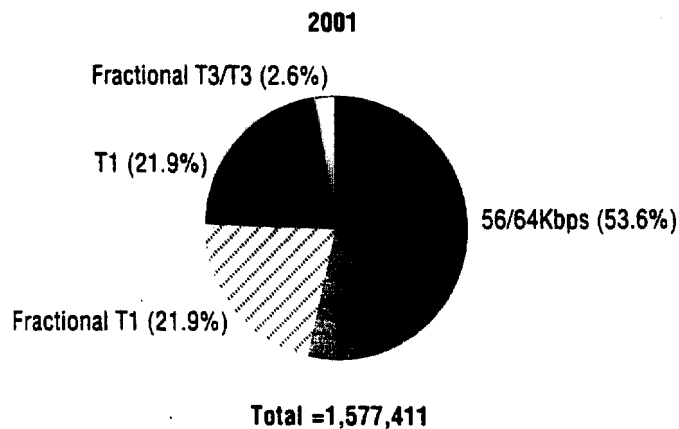
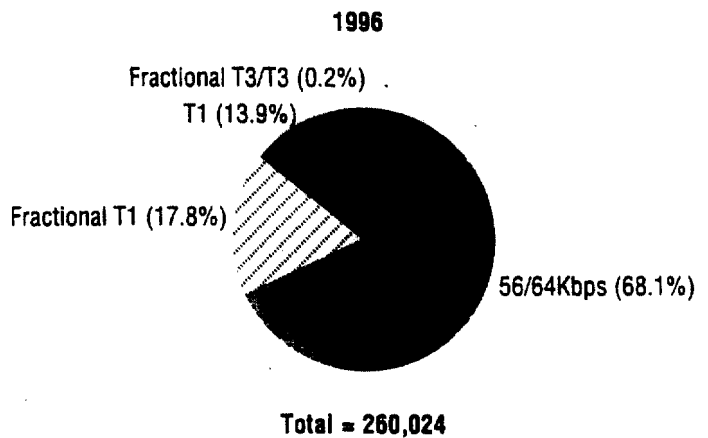
In addition to customer growth and increased average ports per customer, shifts in the port speed mix will fuel frame relay market growth through 2001. As Figure 10 shows, IDC estimates that approximately 68% of all frame relay ports were 56/64Kbps ports in 1996. Fractional T1 ports represented nearly 18% of the total, T1

Table 6
U.S. Frame Relay Customers and Port Installed Base, 1996-2001

	1996	1997	1998	1999	2000	2001	1996-2001 CAGR (%)
Customers	22,696	33,398	46,972	63,138	77,856	89,733	31.6
Ports	260,024	463,114	749,610	1,040,447	1,325,330	1,577,411	43.4
Average ports per customer	11	14	16	16	17	18	8.9

Source: International Data Corporation, 1997

Figure 10
U.S. Frame Relay Port Installed Base Share by Access Speed, 1996 and 2001



Source: International Data Corporation, 1997

ports represented 14%, and fractional T3/T3 ports, an emerging segment, accounted for less than 1% of the 1996 total. By 2001, the higher-speed ports will make up a larger percentage of the total port count, with fractional T1 and T1 ports each accounting for about 22% of the total in 2001, and more than T1 ports representing nearly 3% of the total. As illustrated in Table 7, fractional T3/T3 and T1 ports markets will experience the fastest growth, expanding at 1996–2001 CAGRs of 134% and 57%, respectively.

Table 7
U.S. Frame Relay Port Installed Base by Access Speed, 1996–2001

	1996	1997	1998	1999	2000	2001	1996–2001 CAGR (%)
Under 56Kbps	72	150	240	289	353	370	38.8
56/64Kbps	176,987	295,738	443,891	598,090	736,494	844,621	36.7
Fractional T1	46,176	89,348	160,440	225,433	294,570	346,137	49.6
T1	36,219	76,009	139,491	208,171	274,251	345,885	57.0
Fractional T3/T3	571	1,870	5,548	8,464	19,663	40,397	134.4
Total	260,024	463,114	749,610	1,040,447	1,325,330	1,577,411	43.4

Source: International Data Corporation, 1997

ISPs are using frame relay both for transport (private line replacement) and as an Internet access option.

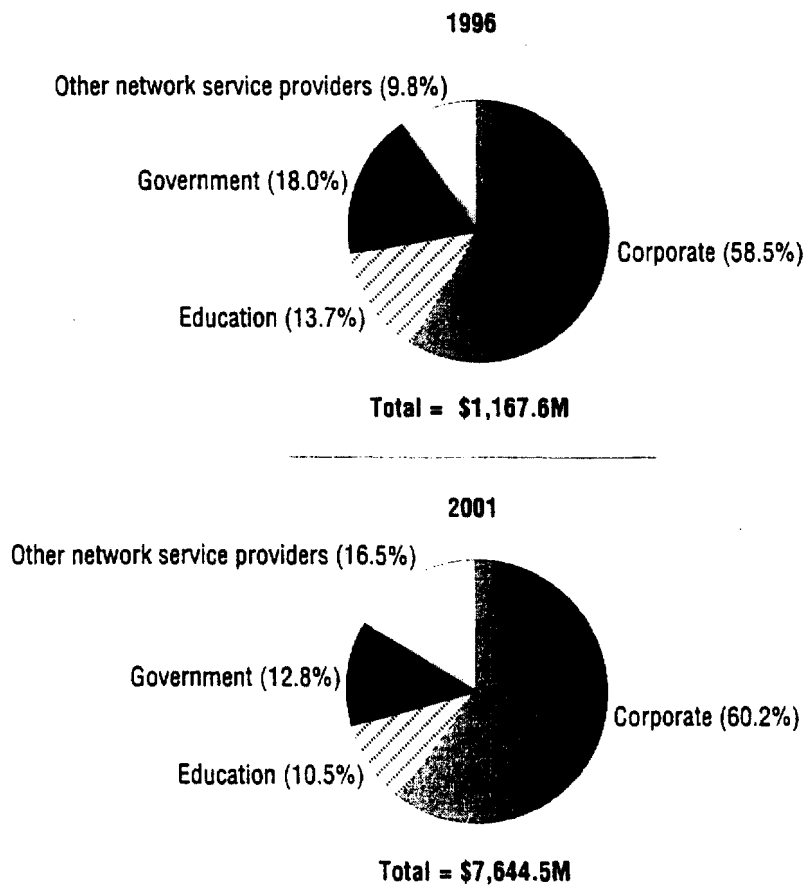
Table 8 and Figure 11 present IDC's frame relay revenue forecast analyzed by customer segment. Corporate customers accounted for 58.5% of total frame relay revenue in 1996, followed by government (18.0%), education (13.7%), and other network service providers (9.8%). Corporate customers will continue to account for the bulk of frame relay service revenue (60.2% in 2001) as frame relay penetrates small and medium-sized companies and as customers increase the number of ports in their networks. The other network service provider segment, composed primarily of ISPs, will experience the most significant growth during the forecast period and will account for 16.5% of total frame relay revenue in 2001. ISPs are using frame relay both for transport (private line replacement) and as an Internet access option. Education and government will decline in terms of overall contribution to the market as frame relay increases its penetration among commercial customers.

Table 8
U.S. Frame Relay Service Revenue by Customer Type, 1996-2001 (\$M)

	1996	1997	1998	1999	2000	2001	1996-2001 CAGR (%)
Corporate	683	1,293	2,201	3,017	3,827	4,605	46.5
Education	161	287	463	599	708	806	38.1
Government	210	371	593	763	888	975	36.0
Other network service providers	114	239	451	688	958	1,258	61.6
Total	1,168	2,191	3,708	5,066	6,381	7,644	45.6

Source: International Data Corporation, 1997

Figure 11
U.S. Frame Relay Service Revenue Share by Customer Type, 1996 and 2001



Source: International Data Corporation, 1997

Market Forecast Assumptions

The following forecast assumptions relate to the frame relay market as a whole (assumptions specific to the local and national/international markets are outlined in the next section):

During the forecast period, LAN-to-SNA applications will be the major market driver as corporations seek to integrate SNA traffic from their legacy systems with LAN-based traffic.

As the frame relay market matures, growth will be fueled by small and medium-sized companies with fewer installed ports.

- Initially, frame relay met the largely unfulfilled market demand for an efficient LAN-to-LAN interconnection service. This market is reaching saturation, but increasing customer requirements (in terms of both bandwidth and interconnection of additional sites) will continue to drive demand.
- During the forecast period, LAN-to-SNA applications will be the major market driver as corporations seek to integrate SNA traffic from their legacy systems with LAN-based traffic. Carriers are encouraging this trend by offering a wider variety of managed FRAD solutions and through the introduction of PVC prioritization.
- New customers and sales of additional ports to existing customers will also play a significant role in the growth of frame relay services. As a result, the 1996–2001 CAGR for ports (43%) will outpace that for customers (32%). As carriers sign on increasingly large customers and as customers respond to carrier pricing incentives that encourage the establishment of more fully meshed networks, the average number of ports per customer will increase from 11 in 1996 to 18 in 2001. In addition, ISPs are becoming an increasingly important customer segment; the ISPs are using frame relay capacity services to support their own dedicated Internet access offerings.
- During the latter part of the forecast period, however, IDC expects to see some slowdown in the growth of the average ports/customer ratio. As the frame relay market matures, growth will be fueled by small and medium-sized companies with fewer installed ports. In addition, as larger customers' frame relay networks grow, they will leverage frame-relay-to-ATM service interworking capabilities to implement ATM at hub site and frame relay connections at the branch sites. All of the IXC's support frame-to-ATM service interworking, and LECs such as Bell Atlantic, Pacific Bell, GTE, and Southwestern Bell have planned to roll out this capability in mid-1997 or late 1997.
- As nondominant carriers in the private line market target AT&T's (and other carriers') customer bases, IDC has seen movement from private line-based networks to public frame relay services. IDC expects this trend to continue as frame relay becomes the de facto LAN interconnection service, although IDC does not believe that there will be a wholesale migration of private line to frame relay services. However, a key benefit of private line networks — the ability to dedicate specific portions of bandwidth to different applications — may be eroded to some extent by the introduction of PVC prioritization and frame relay SVCs.

The increased availability of frame relay managed network services is also driving migration from private line-based networks.

- The increased availability of frame relay managed network services is also driving migration from private line-based networks. Managed services shift responsibility for the WAN to the service provider, allowing customers to focus their attention on the LAN. During the past year, a number of carriers have introduced managed frame relay services or have expanded existing offerings to better serve the growing base of medium-sized customers. In late 1996, AT&T rolled out two new managed offerings — Central Office FRAD and Premises-Based Managed FRAD — in addition to its existing Managed Router Solution. The LECs have also been active. U S West and Pacific Bell introduced managed frame relay offerings in early 1997, and Southwestern Bell plans to roll out a solution for small and medium-sized customers by yearend 1997.
- Migration issues will affect frame relay adversely to the extent that the availability of frame-to-ATM service interworking and T1 ATM encourages customers to implement ATM at their hub sites. At the same time, however, carrier pricing initiatives that emphasize port pricing more than PVC and CIR measurements will encourage users to implement meshed networks with connections to additional sites within the organization. The need for communication among more locations, the increase in peer-to-peer (as opposed to peer-to-hub) communications, and the increasing availability of higher-speed frame relay access are driving the demand for frame relay as these factors also fuel demand for backbone links to ATM.
- Some migration will also take place from X.25 services. IDC expects that this will be strongest in areas outside the United States in which X.25 is more popular. However, this trend depends on the in-country line quality as much as it does on customer demand. Infonet reports that 10–20% of its frame relay business comes from customer migration from X.25.
- IDC believes that pricing pressure will continue as the frame relay market becomes more competitive and expands to target smaller companies. IDC expects to see the greatest per-month price decreases in the 56/64Kbps segment (-3%) during the forecast period. Price decreases in the fractional T1 category will be less significant (approximately -2%). Given the breadth of port speeds subsumed within the fractional T1 category, IDC assumes that customers will gradually migrate toward higher-speed ports. IDC forecasts a steady price trend for T1 ports and a slight increase in the fractional T3/T3 category.
- Dial-up access to frame relay services will play a role in future growth. IDC believes that dial-up access will help providers penetrate smaller accounts as well as remote locations of their larger customers. Most national/international frame relay providers currently offer frame relay dial-up capability (both analog and ISDN), and many local providers are planning to introduce dial-up frame relay service in 1997 or 1998.

Dial-up access will help providers penetrate smaller accounts as well as remote locations of their larger customers.

Carriers are increasingly introducing frame relay service packages tailored to address certain business applications or requirements.

- Carriers have yet to roll out frame relay SVCs. SVCs provide bandwidth on demand, facilitating usage-based pricing for customers with dynamic connection requirements, as well as simplified network management for multisite networks. IDC believes that providers will eventually introduce the service, but some are determining the appropriate price structure. Other carriers have indicated that other enhancements, such as PVC prioritization, are more pressing.
- Another overall driver for frame relay use is Internet access. For corporate users, frame relay Internet access can be more cost-effective than leased-line access. If customers are already frame relay users, they can set up an additional connection for Internet access. Internet service providers are also using frame relay to aggregate backbone traffic.
- Carriers are increasingly introducing frame relay service packages tailored to address certain business applications or requirements, with less emphasis on the technological details of frame relay as a WAN technology. Managed FRAD services, such as those introduced by AT&T and MCI at yearend 1996, fall into this category, as well as voice-over-frame-relay offerings. Sprint's recently introduced frame relay classes of service also highlight this trend toward more application-focused frame relay marketing.
- According to IDC, voice over frame relay will not experience great success in the market for public services, although increased implementation of voice over frame relay for intracorporate communications is expected. Carrier support for voice over frame relay is now limited. Intermedia Communications, Infonet, and Ameritech currently offer branded services. Sprint is planning to introduce a bundled voice-over-frame-relay offering by yearend 1997, and other local and national/international providers are considering rollouts of managed voice-over-frame-relay services. However, IDC believes that voice over IP will prove to be the greater opportunity.
- Competitive local exchange providers (CLECs) such as Teleport, Intermedia, and ACSI are also enhancing their service offerings. However, these providers' services are more competitive with those of the IXC's, given that the CLECs are not bound by the inter-LATA traffic restrictions that require the RBOCs to invest in equipment in each LATA where they want to offer service.
- New access technologies such as DSL may drive the market for higher-speed frame relay service. DSL access to frame relay would allow customers access to the service at fractional T1 speeds via existing twisted pairs more cost-effectively than through private lines.

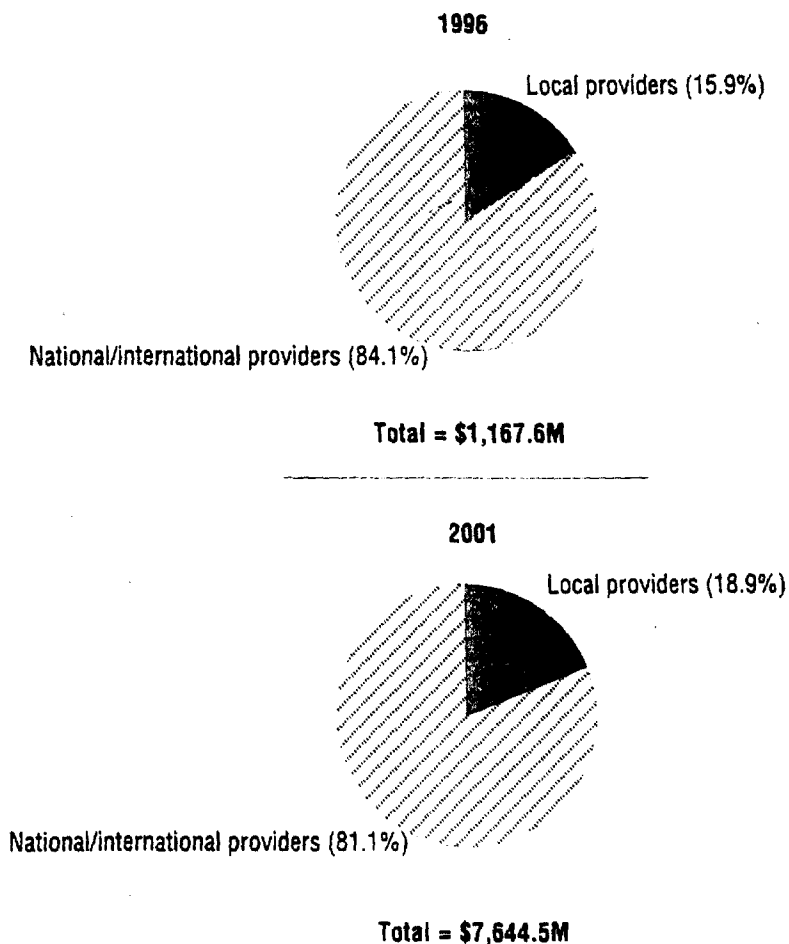
Segmentation Analysis: Local and National/International Market

National/international providers dominate the frame relay market. These providers accounted for 84% of total revenues in 1996.

As shown in Figure 12, national/international providers dominate the frame relay market. These providers accounted for 84% of total revenue in 1996. During the forecast period, IDC expects local frame relay providers' contribution to increase slightly, to nearly 19% of the total market in 2001.

However, the situation looks different when customer and port comparisons are made. Figure 13 shows that local and national providers are more evenly matched in terms of their shares of the total frame relay customer base. Figure 14 shows that local frame relay ports accounted for nearly 38% of the total market in 1996. By the end of the forecast period, IDC expects local providers' port share to increase to approximately 41% of the total market.

Figure 12
U.S. Frame Relay Service Revenue Share by Provider Segment, 1996 and 2001



Source: International Data Corporation, 1997